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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

This Issue

MODERN FARM IMPLEMENTS

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MODERN FARM IMPLEMENTS

DANIEL WEBSTER once said, "When tillage begins, other arts follow. The farmers, therefore, are the founders of human civilization."[1] Since earliest recorded history, progress in the art of tillage has been by means of improved implements, beginning with such simple ones as the bent-stick plow and extending through the complicated harvesting machinery of today. Human muscle was the form of power first used to operate farm implements, but today a farm worker in the United States has an average of 80 horsepower at his command in the form of tractors, trucks, and self-propelled implements.

Over the years, capacities of farm implements to do work have been increased by using wider cuts or swaths, by performing several operations at once, or by operating at higher speeds. They have become at the same time more complex pieces of machinery, costing larger sums of money but returning even more than they cost, if properly handled. Today's farm, large or small, cannot be efficiently and profitably operated without modern farm machinery.

The case for mechanized farming is argued most clearly by a set of figures assembled by Mr. Fred C. Elliott of Texas A. & M. College system, presented in the following table:

Costs of Picking 120 Bales of Cotton on 100 Acres Per Year for 5 Years

Hand Picking	*One-Row Picking Machine*
120 x 5 x $37.50=$22,500	5-year operating expenses including operator, fuel, oil, and repairs — $732.00 x 5 = $ 3,660
	Cost of Picker 10,000
	$13,660

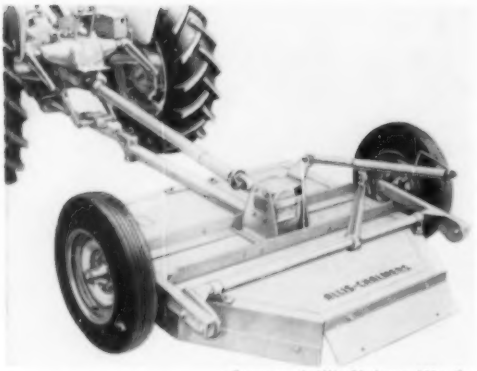
5-Year Net Saving: $22,500—$13,660=$8,840

Even if complete depreciation of the cotton picker in five years were allowed, almost $9,000 saving (and profit) was accrued through its use.

The above figures were compiled for a modest farm of 100 acres: larger farms and larger though more expensive mechanical pickers permit even more startling profits.

Cotton pickers, as well as the many other modern farm machines which perform equally wonderfully in saving human labor, require and deserve the best

[1] "Land of Plenty", Farm Equipment Institute, Chicago, Ill.



Courtesy of Allis-Chalmers Mfg. Co.

Figure 1 — Wheel type rotary chopper driven by power take-off from tractor. Such machines may also be mounted on the tractor's hydraulic lift mechanism, thus eliminating the chopper's wheels.

of maintenance in order to perform their tasks as efficiently and speedily as their designers intended. Regular, careful lubrication with high quality products is the most essential element of such maintenance. This article will describe representative implements used to prepare the ground, seed it, cultivate and harvest the crop. Lubrication of the particular makes of equipment is described primarily to emphasize the desirability and necessity for a Simplified Lubrication plan.

Early models of farm machinery were very simply constructed, using plain bearings of cast iron or wood on cold rolled steel shafts, open gears often with cast teeth, and ropes, leather belts and pressed steel or cast iron link chains for power and motion transmission. Animals furnished the power, hence speeds were low, loads were light, and high friction was ignored. Lubricants were also simple in those days: unrefined, inexpensive, black gear oils, and axle or cup greases generally sufficed.

When the steam traction engine was introduced, speeds and loads on farm machinery increased and farm machinery design was modified to meet the new conditions. Refined straight mineral gear oils, steam cylinder oils and chassis or pressure gun greases replaced the older products. The few internal combustion engines of this era also used straight mineral oils.

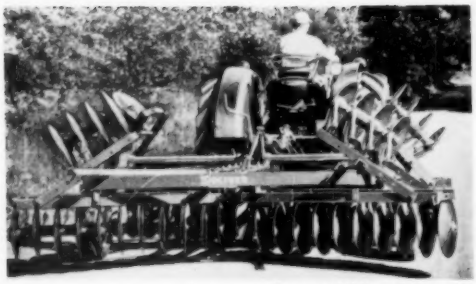
Today's high-powered gasoline and diesel tractors and self-propelled implements with their rubber tires, power steering, automatic or semi-automatic transmissions, and hydraulic implement controls permit still higher speeds and impose still higher loads on the machinery and lubricants. As a result, the latest farm implements feature large numbers of anti-friction bearings. Roller chains are replacing most of the pressed and cast link chains and are in turn being replaced in many instances by "V" belts or universal joint, shaft and gear drives. Gears are usually of the high-quality precision-cut heat-treated type operating in enclosed gearboxes and often carry high loads which demand a gear oil with extreme pressure (EP) properties. A lithium base multipurpose grease is well suited to the requirements of the latest farm machines and may be used for those anti-friction bearings which require yearly repacking as well as pressure fittings requiring more frequent attention. Such a lubricant may often be obtained in sealed paper cartridges which slide easily into a special grease gun, thus eliminating handling of lubricant in bulk and insuring cleanliness of grease and bearings. For best operation, modern internal combustion engines will usually require a heavy-duty type motor oil of API Service Classification MS, DG or DM while certain diesel engines operated under exceptionally severe conditions require an oil of API Service Classification DS (Series III). As farm machinery became more specialized, a few special lubricants were also required which at first could be supplied only by the equipment manufacturers. Cotton picker spindles, the transmission and hydraulic systems of certain tractors, hillside combine drive mechanisms, and centralized lubrication systems on various farm machines are some outstanding examples. Lubricants for these special requirements are now usually obtainable from either the implement dealer or the oil supplier. While the Operator's Manual for the individual machine should always be consulted for details or unusual requirements of the implement's lubrication, it may be too old to encompass latest developments in lubricants. The Simplified Lubrication Plan presented in this issue provides the most recent information on which to base a lubrication program that will save time, money and machinery life.

MACHINERY TYPES

The variety of makes and models of farm machines which are in daily use would stagger the imagination, and no attempt will be made to cover

Courtesy of Oliver Corporation

Figure 2 — Semi-mounted four-bottom moldboard plow. The tractor's hydraulic cylinder can be used to transfer some of the implement's operating load to the tractor's rear wheels to increase traction.



Courtesy of Oliver Corporation

Figure 3 — Tandem disc harrow 16 feet 8 inches wide but folded and supported on wheels for transport on public roads.

them all herein. Instead, the following discussion attempts to include only representative machines which a modern farmer might use to raise several of the common crops. It is realized that the exact machines used in any given area will probably not be represented, but it is believed that the construction and lubrication of farm machinery is sufficiently similar that the discussion will be generally applicable in most areas. The lubrication of tractors,[2] trucks[3] and machinery used in the related dairy industry[4] have been discussed in previous issues.

Rotary Chopper

The first operation in preparing the soil for the crop on many modern farms may be chopping up the stalks of the previous year's crop. A rotary chopper similar to the one in Figure 1, operating on the same principle as a rotary lawn mower, will perform this job effectively. A machine of this type can also be used for cutting sugar beet tops and potato vines or for mowing pastures and clearing brush. Both 2- and 4-bladed cutters with pivoted cutting knives are available as well as a hydraulic lift mechanism. The machine can also be obtained as a tractor-mounted tool without the support wheels.

Lubrication. Daily: grease drive shaft universal joints; work small quantity of grease into rotating drive shaft shield bearings; oil sliding portion of shaft and shield. Every 100 hours: check level of SAE 140 transmission oil in gearbox. Every 250 hours: apply 20 "shots" of pressure gun grease to extension of gearbox into cutter housing. Annually: drain, flush and refill gearbox.

Moldboard Plow

Figure 2 shows a semi-mounted 4-bottom moldboard plow. Its weight is partly carried by the tractor and the tractor's hydraulic cylinder can be used to transfer part of the load on the implement to the tractor's rear wheels to increase traction. Each individual plowshare is mounted on a spring trip which allows the plowshare to swing back when an obstruction is hit, to avoid serious damage. The trip is reset by simply backing the tractor.

Lubrication. Weekly: check and oil trip parts to insure freedom; if rusted apply penetrating oil. Annually: repack coulter (turf cutter) and wheel bearings with grease.

Disc Harrow

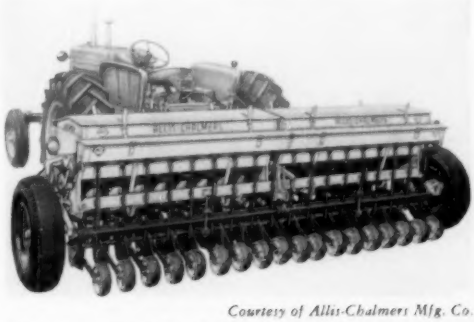
The disc harrow is widely used to create a finer seedbed after plowing. Figure 3 shows a tandem disc harrow 16 feet 8 inches wide which may be folded to less than 12 feet for transport. This folding technique is also applied to other tools, such as planters, which in the interests of greater work output per hour in the field have been made too wide for public roads. Its rubber-tired transport wheels are hydraulically raised and lowered and serve to regulate the depth of cut in the field.

Lubrication. The particular harrow shown is equipped with sealed permanently-lubricated bearings.

Grain Drill

Figure 4 shows a grain drill used to plant and initially fertilize a wide variety of small to medium sized seeds in continuous rows seven inches apart. The hopper is divided lengthwise into compartments for seed and fertilizer, and a separate small hopper for grass seed is mounted on the back of the main hopper. All the hoppers have metering devices every seven inches along their bottoms which are driven by open pressed steel chains from sprockets on the support wheels. Disc openers similar to those on a harrow open a furrow where the seed is dropped while the fertilizer is placed to the side of the seed and below it to avoid "burning." The rubber tired press wheels press the soil down on the freshly planted seed. Many other devices for placing the seed in the ground and covering it are also used, as conditions and individual preference dictate.

Lubrication. Daily: grease depth and press wheel cranks, cross shaft idlers, seed and agitator cranks, press wheels, and from 15 to 24 single disc openers (centralized lubrication systems consisting of a grease or oil reservoir, hand injection pump and nylon tubing to each lubrication point are available on another make to reduce lubrication time and labor); oil clutch shaft bearings and chain tighteners. Annually (after planting): clean and oil seed and fertilizer metering mechanisms to prevent rusting during storage but remove oil before using; repack sealed bearings in transport wheels and double disc openers with grease.



Courtesy of Allis-Chalmers Mfg. Co.

Figure 4 — Grain drill with separate compartments for grain and fertilizer and a small separate hopper for grass seed.

[2] LUBRICATION, Feb. 1955, "New Developments in Farm Machinery"

[3] LUBRICATION, May 1960, "Bus and Truck Lubrication"

[4] LUBRICATION, June 1960, "Dairy Industry"

Courtesy of Minneapolis-Moline Co.

Figure 5 — Four-row planter with dry fertilizer applicators.

Corn-Cotton Planter

Figure 5 shows a four-row corn-cotton type planter with dry fertilizer applicator. Both dry and liquid types of fertilizer equipment are generally available for most planters and drills, to suit the farmer's preference. Two such four-row units are frequently hitched in parallel to plant eight rows in a single pass. These units will be taken apart and drawn in tandem for road transport. Two grain drills, disc harrows, or any similar implements can also be so handled.

The corn-cotton type planter can handle a wider variety of sizes and shapes of seed than the grain drill and can meter seed more accurately, counting out small beet seed or whole peanuts one by one! Two different types of seed can also be planted at once. As with the grain drill, a wide variety of devices for placing the seed in the ground and covering it are available. Row spacings with this type planter are usually in the range of 36 to 40 inches, but individual planter units may be mounted on tool bars or cultivator frames to plant almost any spacing desired. The spacing of seed along the row can also be varied from an almost continuous stream called "drilling" to the dropping of one or a measured number of kernels (called a "hill") at regular intervals up to about 40 inches. Stretching a wire with "buttons" on it about 40 inches apart across the field and allowing the buttons to trip the planter mechanism to plant hills of seed, spaced as far apart along the row as the distance between rows, allows cultivation both along the row and across it to keep weeds from growing between the plants in the row. This practice, called check rowing, is being replaced by drilling, where the plants are so close together the weeds can hardly grow between them. Many planters offer an attachment to distribute an herbicide on top of the row after planting, which discourages weed growth in the row until the plants can take over, and herbicide is also applied during the growing season for this purpose, in an effort to minimize time spent in cultivation. There is some indication that if sufficient fertilizer is applied, corn will yield heavily in spite of the weeds.

The rubber tired support wheels of this planter drive the seed and fertilizer metering mechanisms under the hoppers by means of open chains, counter shafts, and open gears.

Lubrication. Daily (every 8 hours of operation): grease 28 points; oil 8 points. (Seed metering mechanisms are not usually lubricated, however one extra high speed planter of another make uses powdered graphite mixed with the seed for this purpose). Annually (after planting): preferably clean and paint fertilizer hoppers, optionally oil but remove oil before reuse; grease runners.

Cultivator

Figure 6 shows a typical 4-row tractor-mounted cultivator working in corn. Mounting the cultivator on the front of the tractor permits precise control and avoids uprooting desirable plants. A wide variety of different shovels and other attachments to suit various crops and individual preference is available. Tractor-mounted cultivators are now made in widths up to 8 rows, to suit crops planted with up to 8-row planters.

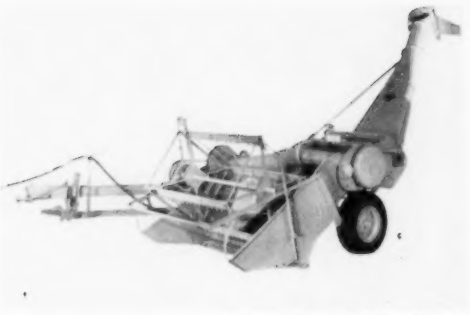
Lubrication. Modern cultivators usually have individual hydraulic lifts for each section and require only periodic oiling of the various linkages and greasing of gauge wheels.

Forage Harvester

Beginning about 1880 green corn stalks complete with ears have been chopped and stored in silos to furnish winter feed for dairy cattle. Since 1936 green hay or grain has been chopped into ensilage which has greater food value than dried hay. Figure 7 shows a forage harvester, which is basically a chopping machine with attachments to cut and gather either standing grain or hay crops (as pictured) or row crops such as corn. The corn attachment uses "gathering chains" like those on the corn picker described in the next section. In addition, a windrow pickup attachment is available which will allow field chopping of crops which have been cured in the windrow for mow storage. The machine shown uses a cylinder-type cutter somewhat like the blades of a reel-type lawn mower which requires less power than the older flywheel type. The knives of

Courtesy of Tractor & Implement Division, Ford Motor Company

Figure 6 — Four-row cultivator mounted on front of tractor to facilitate accurate steering and precise cultivation.



Courtesy of Allis-Chalmers Mfg. Co.

Figure 7 — Forage harvester which cuts a standing grain crop, chops it and throws the ensilage through the chute into a trailing wagon.

the cutter are cupped so as to throw the chopped material up the chute and into a wagon or truck. All drives in this machine have anti-friction bearings, some of which are sealed.

Lubrication. Every 4 hours: grease 4 bearings on upper feed roll. Daily (every 8 hours of operation): oil linkages, roller chains and moving parts not equipped with pressure gun fittings; grease 13 bearings on power take-off drive shaft from tractor, lower feed roll bearings, cylinder bearings and idlers; grease 8 fittings on grass attachment (shown in Figure 7); grease 24 fittings on row-crop attachment (not shown). Twice Weekly: lubricate sickle drive hubs on grass and row crop attachments. Keep power take-off gearbox filled with SAE 140 gear lubricant and sickle drive housing with SAE 40 motor oil.

Corn Picker

Corn ears used to be individually and laboriously picked by hand from their stalks, carted to the barn, husked or shucked individually as opportunity offerred and eventually stored in cribs. In contrast, Figure 8 shows a modern farmer operating a tractor-mounted cornpicker which automatically removes the ears from two rows at a time, husks them and delivers the corn ears into a trailing wagon. This ingenious machine is actually an attachment which is readily applied or removed from the tractor in about two hours of time. Even when the cornpicker is installed, the tractor is useable for most ordinary purposes.

As may be seen in Figure 8 the tractor is driven between the two rows and the cornstalks in each are gathered into identical slots on each side of the machine. Here they are caught and drawn in by lugged gathering chains and passed between snapping rolls which snap off the ears. The stripped stalk is thrown out of the machine while the ears are fed over counter-rotating rubber rolls which rub off the husks. An air blower removes husks or dirt and an elevator transports the husked ears upwards and backwards into the wagon. At the same time, any kernels of corn that are incidentally removed from the ear by the husking rolls are also saved, cleaned and blown into the wagon. Machines are also available as attachments to corn pickers which take the additional step of shelling the corn, cleaning and blowing the kernels into a trailing wagon and leaving stalks, husks and cobs in the field to contribute to fertilization.

Lubrication. Weekly (every 60 working hours): one or two "shots" of pressure gun grease in each of a total of 44 fittings. (Some machines by other manufacturers have larger numbers of lubrication points requiring attention as frequently as every four hours; in such instances the installation of a centralized lubrication system like that already described under "Grain Drill" would be advantageous).

Combine

The self-propelled combine could probably be called the king of the farm machines. It performs many operations formerly carried out by a large crew of men and separate machines, uses only one operator, and can handle a wide variety of seed and grain crops. Figure 9 shows a cut-away view of a self-propelled combine. The top mounted engine propels the machine through a hydraulically operated variable speed drive plus a clutch and 3-speed transmission connected to the large front wheels. Since the threshing mechanism runs at a constant speed, the variable speed drive allows the combine's forward speed to be varied to accommodate changes in the density of the crop being harvested. The grain is cut by the sway bar driven sickle and the variable speed reel directs the grain to the platform auger whose speed may also be varied to meet changing conditions. The feed rake delivers the grain from the auger to the cylinder, where the grain is threshed between the rub bars and the concave (perforated screen). Cylinder speed and concave clearance are adjustable from the driver's seat. The beater directs the straw from the cylinder to the straw walkers, and any remaining grain is shaken into the grain sieves where the chaff is blown away by an air blast and the clean grain falls into the grain elevator which carries it to the grain tank. The grain tank is unloaded periodically by an auger into a truck or wagon.

Courtesy of Massey-Ferguson Ltd.

Figure 8 — Tractor-mounted two-row corn picker and shucker delivering ears into trailing wagon.

Courtesy of J. I. Case Company

Figure 9 — Cutaway view of a self-propelled combine. Its top-mounted engine propels the machine through a variable speed belt drive which allows the forward speed to be varied to accommodate variations in crop density while the threshing mechanism operates at a constant optimum speed.

Lubrication. Daily: grease 23 points; grease 14 additional points on rice combine tracks (if used). Weekly: grease 11 points; check level and if necessary replenish SAE 90 gear lubricant in transmission, steering housing and planetary rice wheel hubs (if used) and SAE 10 non-detergent motor oil in hydraulic system. Every 120 hours: grease engine fan shaft bearing; drain and refill engine crankcase (SAE 10W below 32°F., SAE 20W between 32 and 80°F., SAE 30 above 80°F.). Annually or every 240 hours: repack rear wheel bearings with wheel bearing grease; replace engine oil filter. Every 500 hours: grease governor lever.

Combine With Corn Head

Figure 10 shows a two-row corn head on a medium-sized combine. The corn is snapped from the stalks by snapping rolls similar to those used on a corn picker and delivered by an elevator to the combine cylinder, where the husks and kernels are rubbed off the cobs. The cobs and husks pass out over the straw walkers and other "trash" is separated from the shelled corn by the sieves and fan. More than 100 sealed bearings on the basic combine greatly lighten the task of periodic lubrication.

Lubrication. Every 4 hours: grease two fittings. Daily (every 8 working hours): grease 9 fittings; grease 22 fittings on corn head (when used), clean and refill engine oil bath air cleaner with new engine oil. Every 40 hours: grease 16 fittings; grease 2 fittings on corn head (when used). Every 50 hours: grease 1 fitting; grease 2 fittings on corn head (when used); drain and refill engine crankcase with premium grade oil (SAE 10W below 32°F., SAE 20 between 32°F. and 75°F., SAE 30 above 75°F.); check and if necessary replenish steering gear, transmission and differential with SAE 90 gear lubricant; check and replenish hydraulic system with manufacturer's brand of hydraulic oil. Every 100 hours: replace engine oil filter; coat chains thinly with oil, run a few minutes, and wipe off excess.

Mower and Hay Crusher

The Bible says, "all flesh is grass," and various types of hay still represent an important crop on a great many farms. Figure 11 shows a tractor-mounted mower teamed with a crusher for cutting and crushing the crop in a single pass. The mower is a conventional semi-mounted pitman type with hydraulic lift control, with special provision for attaching the hay crusher drive-shaft to the mower drive pulley. The crusher uses a gearbox, cross shaft, and chain to drive the counter-rotating rolls which

Courtesy of Tractor & Implement Division, Ford Motor Company

Figure 10 — Two-row corn head installed on a combine which picks, shucks, shells the ears and temporarily carries the cleaned corn kernels in its grain tank.

Courtesy of New Holland Machine Company

Figure 11 — Tractor-mounted mower teamed with a hay crusher. The counter-rotating crusher rolls are driven by a shaft from the rear of the mower.

crush the stems of the hay to allow them to dry before the leaves fall off, thus saving valuable nutrients in the leaves.

Lubrication. Every 2 hours: grease 3 fittings on mower. Every 4 hours: grease 4 fittings on mower. Daily: grease 11 fittings on mower; grease universal joints and crank bearings on crusher; oil threads on crusher roll tension spring crank. Every 50 hours: disassemble and grease sliding portion of mower power take-off shaft; grease 2 fittings on mower caster wheel and frame; oil crusher lift crank thrust bearing, over-riding clutch pins, roll drive chain, sliding members of power take-off assembly (but not shields); replenish crusher gearbox with SAE 140 gear oil. Annually (after use): repack crusher wheel bearings; grease crusher hitch hinge points, tension spring pivot brackets, over-riding clutch pilot shaft.

Self-Propelled Windrower

Where uneven ripening of a grain requires it to be cut and cured in a windrow before threshing, a self-propelled windrower like that shown in Figure 12 might be used. Such a machine could also be used where its 10 to 16 foot cutting width was required by a large hay crop. The knife and reel are similar to those on a combine header, and the cut grain falls on canvas drapers which carry it to the opening in the center of the machine and form a crisscrossed windrow. The gearless transmission uses variable and direct "V" belt drives, and the only chains on the machine are in the enclosed final drives. The cutter and reel height are hydraulically adjusted.

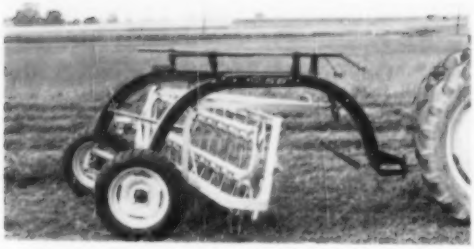
Lubrication. Every 4 hours: grease 7 fittings. Daily: grease 19 fittings; clean and refill engine air cleaner cup. Weekly (50 working hours): grease 3 fittings; change engine oil; oil sickle and hold-down clips unless cutting at ground level or in dry sandy soil. Annually: drain and refill hydraulic system with SAE 30 motor oil; drain and refill gear cases with SAE 80 gear oil.

Side Delivery Rake

Figure 13 shows a side delivery rake, a type of tool used more than any other to form windrows preparatory to baling or pickup by combine or forage harvester. The ground wheels drive the reel

Courtesy of J. I. Case Company

Figure 12 — Self-propelled windrower with hydraulically adjustable cutter and reel heights and "V" belt drives.



Courtesy of New Holland Machine Company

Figure 13 — The ground wheels of this side delivery rake drive its reel through a shaft, universal joints and gear box.

bearing the tine bars by means of universal joints, shafts and a gearbox. The spring-mounted tines on the tine bars sweep across the swath and roll the hay into windrows with the leaves inside and the stems outside for best curing and maximum leaf retention.

Lubrication. Weekly: replenish gearbox with SAE 140 oil; oil or grease sliding members of telescoping assembly except when operating in extremely dusty or sandy conditions. Annually (or after 100 acres): grease 11 fittings; oil lift linkage, pivot ball and clutch throw-out lever. Triennially (or after 1000 acres): disassemble, clean sealed bearings on tine bar and spider, repack with wheel bearing grease.

Automatic Pickup Baler

Handling the hay from the field to the mow was once a back-breaking task, but today's farmer can put his hay crop safely into the barn with scarcely a hand having touched it. A machine which plays a large part in this accomplishment is an automatic pickup baler like that shown in Figure 14. The machine shown has an attachment which projects half-sized bales through the air into a wagon trailing behind the baler. (A bale in mid air may be seen in the illustration.) A control on the tractor allows delivery of the bale to be delayed while turning a corner to keep it from missing the wagon. The baler is driven from the tractor's power take-off through a shaft, universal joints, and a gear case. The spring teeth on the floating pickup lift the hay from the windrow into the floating auger which moves the crop to the fork-type feeder. The feeder moves the hay into the bale chamber, where it is cut off and packed by the reciprocating plungerhead. A heavy

Courtesy of Deere & Company

Figure 14 — Automatic pickup baler which picks up the hay windrow, forms half-size bales and projects them into a trailing wagon. Note bale in mid-air.

Courtesy of International Harvester Company

Figure 15 — Two-row mechanical cotton picker which removes the cotton from ripe bolls only, sucks it off the picking units and blows it into the storage basket on top of the machine.

flywheel smooths out the varying power requirements of this operation. When the bale reaches the proper size, it is tied by a twine knotter or wire twister and moved out of the bale chamber to the wagon.

Lubrication. Daily: grease 38 fittings. Annually: grease 7 fittings on knotter sparingly to avoid excess; repack wheel bearings with wheel bearing grease; drain, flush and refill main gear case with SAE 140 oil and 1000 rpm chain case (for tractors with 1000 rpm power take-offs) with SAE 30 oil. Grease flywheel bearing whenever shear bolt is replaced. Remove and wash stiff or gummy chains in kerosine, dry, dip in oil, drain excess and replace on machine.

Cotton Picker

The mechanical cotton picker is one of the most amazing of farm machines. The very idea of a machine that can pluck cotton from ripe bolls on a plant while leaving the unopened bolls to ripen for later picking staggers the imagination. More development work is said to have gone into the mechanical cotton picker than any other farm machine, but as previously pointed out the results have been well worth the effort.

Figure 15 shows a two-row mechanical cotton picker which is essentially a tricycle-type tractor running backward and pushing the spindle-type picking units ahead of it. These units contain front and rear drums, each having a rotor mounting "picker bars" with 20 spindles on each, for a total of 1040 spindles per machine. The spindles rotate continuously and are passed among the branches of the cotton plants as the machine moves along the row. Barbs on the spindles catch the cotton fibers of open bolls, but leave unopened ones undisturbed. The cotton winds around the spindles and is withdrawn from the plant, then passes under rubber "doffers" which unwind the cotton. Air from a fan sucks the cotton up and blows it into a basket on top of the machine which is hydraulically dumped when full into a truck or wagon.

Lubrication. Daily (every 10 hours): with machine warm, flood picker bars with rust and oxidation inhibited oil (SAE 10W below 80°F., SAE 20 between 80°F. and 95°F., SAE 30 above 95°F.), drain for at least one hour, and run slowly for 15 minutes with picker drum doors open before resuming picking; apply 4 "shots" of grease to each of 4 picker bar cams; apply 3 "shots" of grease to each of 52 picker bar bearing caps and the clutch release shaft; oil 16 points on chain and gear drive of picker drums with SAE 20 non-detergent oil; apply oil to drum and doffer drive chains with 1 inch brush. Every 30 hours: grease 6 fittings on steering system, 14 on picker fan and main drives, 8 on drum lifting mechanism, and 2 on the bottom of the picker drums. Every 50 hours: grease clutch release sleeve, drain and refill engine crankcase (SAE 10W below 32°F., SAE 20 between 32°F. and 80°F., SAE 30 above 80°F.). Every 150 hours: oil ratchet clutch on picker drum drive; oil generator. Annually: hand grease 4 lower doffer shaft bearings; grease engine distributor; apply short fiber grease inside safety clutch hub; drain, flush and refill hydraulic fluid reservoir with manufacturer's brand of

oil; drain, flush and refill steering gear, drum, ground chain drive and differential gear housing with SAE 90 lubricant; drain, flush and refill transmission fan and picker drive housings with SAE 90 extreme pressure lubricant; repack drive and guide wheel bearings with wheel bearing grease.

Lubricants and Lubrication

A comment on the tremendous number of makes and types of farm implements in use around the world has already been made. A goodly number of makes and types, of various ages, can usually be found on the average farm, and a formidable stock of grades and types of lubricants would be required to service them if all the lubricants that were recommended when the machines were purchased were used. However most farmers can profit greatly by adopting a Simplified Lubrication Plan which makes maximum usage of only a few high quality multipurpose lubricants. The slight additional cost of high quality lubricants will be more than offset by the economy and simplicity of handling and stocking fewer containers and by precluding the expensive error of trying to use a low performance lubricant where a high performance one is required. Thus a small number of high quality lubricants like those described in Table I will amply satisfy most of the lubrication requirements of the agricultural equipment on most farms.

Hydraulic cylinders on most tractor-drawn implements are filled and operated by the tractor's hydraulic system and will not be discussed in this article.

In addition to the lubricants shown in the Simplified Lubrication Plan and depending upon the recentness and definiteness of the equipment manufacturer's recommendations, a few special single-purpose lubricants may be required.

The purchase of high quality lubricants is the starting point for an effective maintenance program but these lubricants will be of no value unless they are properly applied at the proper intervals. The greatest care should be exercised to keep dust, dirt and other contaminants from the lubricants. Grease fittings should be wiped off with a clean cloth before applying the grease gun. Dirt should be cleaned away from around the filler opening of any lubricant reservoir before opening it and care should be exercised to see that dirt does not blow or fall into the reservoir while it is open. Only scrupulously clean containers should be used to handle lubricants and no attempt should be made to "clean up" a lubricant suspected of being contaminated. For example, it is worse than useless to try to "filter" oil through a piece of cloth, since only the larger contaminated particles are removed and lint from the fabric itself adds to contamination. The scraping of a "heel" of grease from a practically empty drum into a new one is to be discouraged, since the likelihood of introducing dirt into the new drum during this operation is so great that it becomes an unprofitable risk. Lubricant containers should be stored indoors in a clean dry spot and kept tightly closed when product is not being taken out of them. If outdoor storage is unavoidable, place lubricant containers on their sides so that water can not collect on their heads and be sucked into them. Grease gun fillers which allow the gun to be filled without opening the lubricant container are highly recommended. The use of greases in cardboard tubes which fit into a special grease gun is an even better method of preventing contamination. It is well to remember that the best lubricant in the world, if contaminated with dust or dirt, can become a powerful lapping compound which will quickly wear out the machine it is intended to preserve. The need for care does not end when the lubricant is placed in the machine, for unless breathers and air filters receive daily maintenance or even more frequent attention in very dusty surroundings, the dirt will contaminate the lubricant in the reservoir with disastrous results. Periodic inspection and replacement of oil and grease seals will help to prolong the life of the bearings they protect, and such work as well as relubrication of the bearing involved should be performed carefully in clean surroundings.

EQUIPMENT STORAGE

Preparation of farm machinery for storage is just as important as proper lubrication during use. Since typical farm implements are used only 10 to 15 days a year[5] and spend the remainder of the time in storage, they may be said to have worn out more in storage than in actual use. The conditions of storage and the attention given to the machinery when it is put into and taken out of storage will largely determine whether the few days of service obtained by the farmer each year from his machine are trouble-free and profitable, or are complicated with breakdowns which delay operations, cause needless expense, and possibly result in loss of crops due to changing weather conditions. They will also largely determine how long the machine will last.

The manufacturer's instruction manual furnished with each farm implement is the best authority on details of storage of specific implements, however the following general observations on storage of farm implements are believed to be applicable to most machines.

Machines should be stored indoors and protected from the damaging effects of water, sunlight, and manure fumes. While all the lubricants described in the Simplified Lubrication Plan will provide considerable rust protection during storage a good rust-proof compound affords maximum protection of surfaces exposed to the atmosphere. This is a grease

[5] "The Cost of Using Farm Machinery" by Fenton and Fairbanks, Kansas State College Engineering Experiment Station Bulletin No. 74.

TABLE I
SIMPLIFIED LUBRICATION PLAN FOR AGRICULTURAL IMPLEMENTS

Mechanism	Lubricant	Recommended Grade 90°F-32°F.	32°F.-10°F
Grease Fittings Plain Bearings Ball and Roller Bearings Universal Joints, grease lubricated Wheel bearings	**MP**	NLGI #2, All-season	
Gear Boxes Chain Drives Flexible Couplings Universal Joints, oil lubricated	**MG**	SAE 140	SAE 90
Exposed Gears	**C**	All-season	
Gasoline, LPG, Diesel Engines (normal service), Air Cleaners	**H**	SAE-30	SAE-10W
Diesel Engines, (severe service, supercharged, or fuel sulfur above 0.5%), Air Cleaners	**U3**	SAE-30	SAE-10W
Hydraulic Systems, general	**R**	R_c	R_B
Engine oil specified	**H**	SAE 30	SAE 10W
Automatic transmission fluid specified	**T**	All-Season	

Lubricant	Description	App. Oil Viscosity (SUS @ 100°F.) or NLGI Grease Grade
MP	Multipurpose Grease for ball, roller, needle and plain bearings: lithium soap type containing low-pour high-viscosity (81 SUS @ 210°F.) oil; wide useable temperature range; highly resistant to oxidation, high temperatures, water washing and bearing leakage; preferably supplied in grease gun cartridges.	2
MG	Multipurpose Gear Lubricant: high load capacity; "universal", or multipurpose; rust, scuff, wear and corrosion preventive; oxidation-resistant; surpassing military specification MIL-L-002105A and recommended for API Service GL4.	2600 (SAE 140) 1000 (SAE 90)
C	Open Gear and Wire Rope Lubricant: extremely adhesive; extreme pressure; highly water resistant; rust preventive; with volatile solvent to facilitate easy brush application.	Application: 2500 Operation: 2000 @ 210°F.
H	Engine Oil for gasoline and diesel engines: highly detergent; highly dispersant; oxidation and foam inhibited; wholly distilled; very high viscosity index; rust, wear and corrosion preventive; low pour; minimum API Service Designation of DM.	550 (SAE 30) 200 (SAE 10W)
U3	Engine Oil for diesel (and gasoline) engines: very highly detergent; highly dispersant; oxidation and foam inhibited; rust, wear and corrosion preventive; minimum API Service Designation of DS.	625 (SAE 30) 175 (SAE 10W)
R	Hydraulic Oil: low pour; non detergent; oxidation, rust and foam inhibited.	R_c, 300 R_B, 150
T	Hydraulic Oil: Automatic Transmission Fluid Type A, Suffix A; low pour; oxidation, rust and foam inhibited; fully qualified with ATF approval number.	200

type material with a petrolatum base to which rust inhibitors have been added. It is available in a variety of grades for brush or spray application, provides long lasting protection, but is easily removed with kerosine when the period of storage is over.

Before a machine is stored, it should be thoroughly cleaned, since dirt attracts moisture and both cause rust. Care should be taken however during cleaning not to force water or solvents into sealed bearings. After cleaning, the machine should be dried and thoroughly lubricated. Seed and fertilizer hoppers, tanks, etc. should be emptied. Particular care should be taken to remove all traces of fertilizer, insecticide, and seed-treating chemicals from machinery, since they may be very corrosive. After cleaning, oil or paint is usually recommended for surfaces which have been in contact with chemicals. As a general rule, parts which operate in contact with crops or the soil and have become polished as a result are protected best with a film of rust-proof compound, although some greases and heavy oils can furnish partial protection. It may be argued that if parts rust in storage, they will wear bright again in use, but if parts such as plowshares and harrow discs once rust, they will never again pull as easily as when new, even though the rust is later removed. Parts such as chains, mower knives, and seed and fertilizer metering devices which are normally lubricated sparingly, if at all, are usually scheduled for protection during storage with oil, which is more easily removed from such parts than grease or rust-proof compound. Chains should be removed and cleaned, along with the sprockets, before oiling. Rubber and canvas items, such as "V" belts and combine canvasses, should be removed, cleaned, and hung up in the dark out of reach of animals. They may be wrapped in sacking to keep them clean. Rubber tires should be stored fully inflated, out of direct sunlight, and off the ground. They need not be removed from the machine unless it is necessary to store it out of doors. The lower metal parts of machinery should be kept from direct contact with the earth as far as possible. In general, covered, preferably indoor storage is recommended for farm machinery, but where outdoor storage must be employed, protection of at least the most important parts of the machine by means of tarpaulins is recommended. Hydraulic cylinders should be operated so as to draw their shafts inside. Before storage internal combustion engines should be drained and refilled with new crankcase oil, operated a few minutes, then the fuel system drained. It is also a good idea to remove the spark plugs, pour an ounce of oil into the cylinders, turn the engine over a few times with the starter, then replace the plugs. Storage batteries should be removed, kept charged, and protected from freezing. All openings into the engine should be plugged or tightly covered. Tension should be removed from springs anywhere on the implement wherever possible. Touching up scratches and worn places on the painted surfaces of farm machinery will preserve the appearance and trade-in value of the machine and probably will save replacing rusted-out parts later on.

At the time of the last use of the machine, while its operating characteristics are still firmly in mind, a list should be made of needed repairs. Major repairs and adjustments of complicated machinery are probably best performed by the implement dealer during the "off" season. Parts for needed repairs which can be made by the farmer should be ordered early so that this work, too, can be done before the machine is needed again. Replacement of worn parts when the first signs of serious wear are noted will often save larger repair bills due to worn parts placing an undue strain on other sound parts.

When the machine is to be removed from storage for use, all parts which had been removed should be replaced and the machine completely relubricated. Protective materials should be removed. All moving parts should be checked by hand to be sure they are free before power is applied, and if stuck should be worked free gently, using solvent such as kerosine. Slip clutches and other safety devices such as trips on cultivator standards and plow shares should be checked to be sure they will work. Necessary adjustments should be made to place the machine in top operating condition. Any effort expended before the time of use to insure that a machine will run smoothly and efficiently will be well repaid when the working season starts with maximum output and interruption-free operation. Careful attention to lubrication and adjustment of the machine during the season of use will assure the continuance of this performance.

SUMMARY

Over the years, farm implements have tremendously increased their capacity to do work until today's farmer, large or small, cannot afford to be without modern farm machinery. Wonderful and essential as it is, however, the best farm machinery is no better than the maintenance it receives. Frequent and careful lubrication with clean, high quality lubricants is an essential part of good maintenance. The task of lubrication of a varied collection of implements on a modern farm may be considerably eased by use of a simplified lubrication plan to reduce the number of types and grades of lubricant employed to a bare minimum. The cost of stocking higher quality lubricants for some less critical uses will be offset by savings in time in handling many grades of lubricant. Farm machinery spends far more time in storage than in use and petroleum products can play a significant part in minimizing deterioration of machinery in storage for maximum life and trade-in as well as efficient trouble free, profitable operation in the field.

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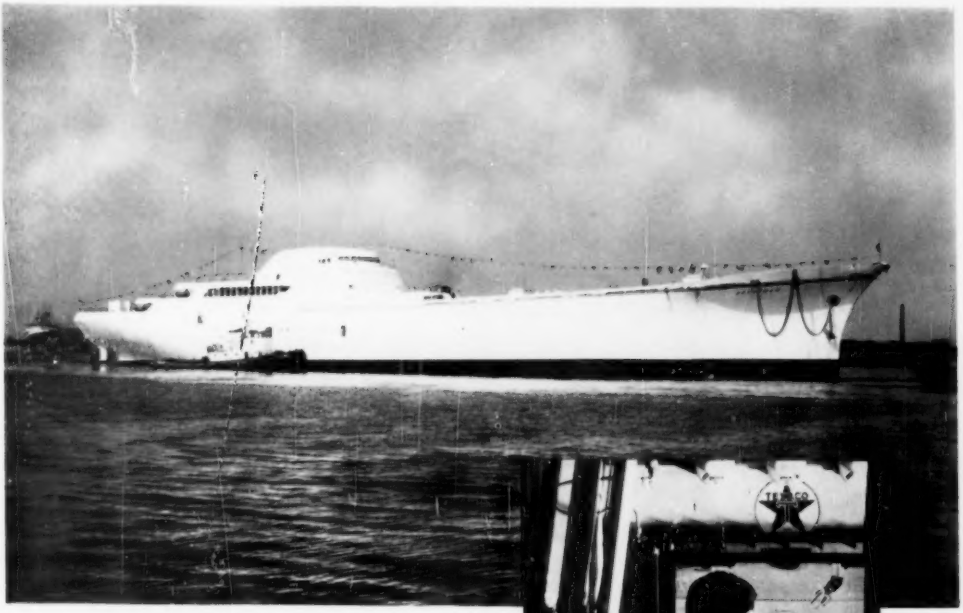

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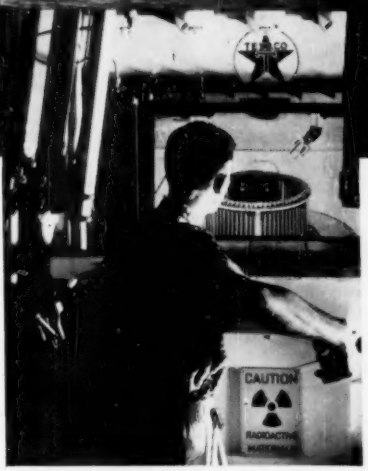

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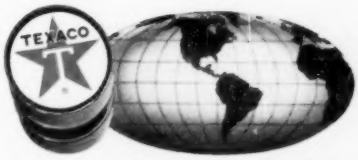

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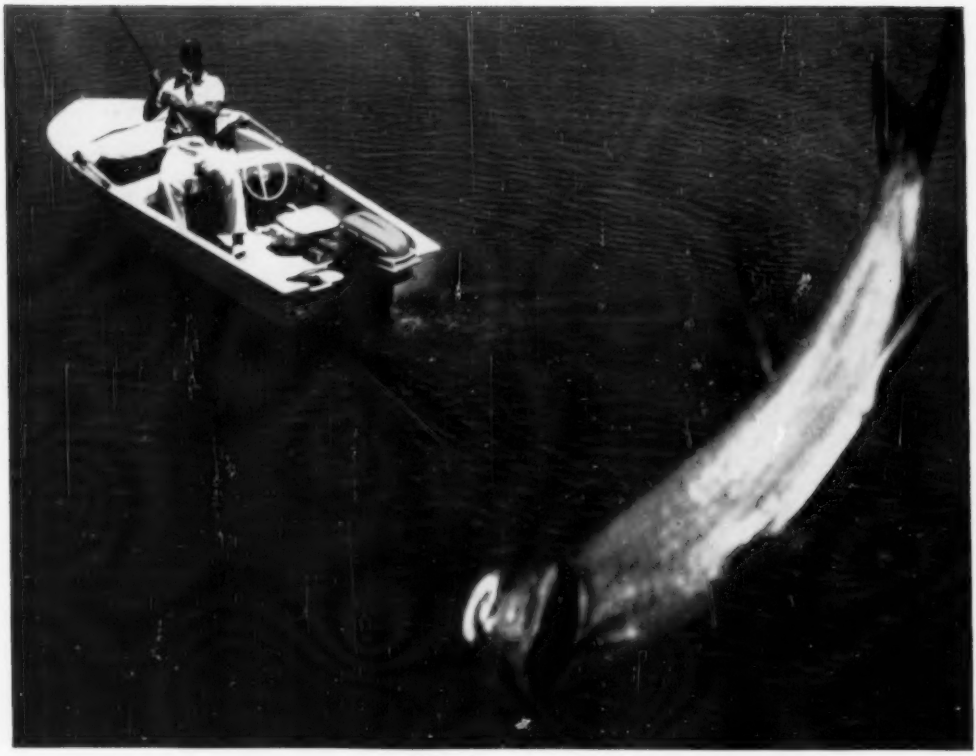

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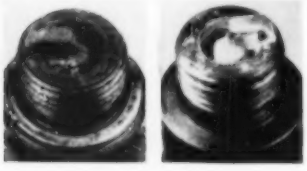

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